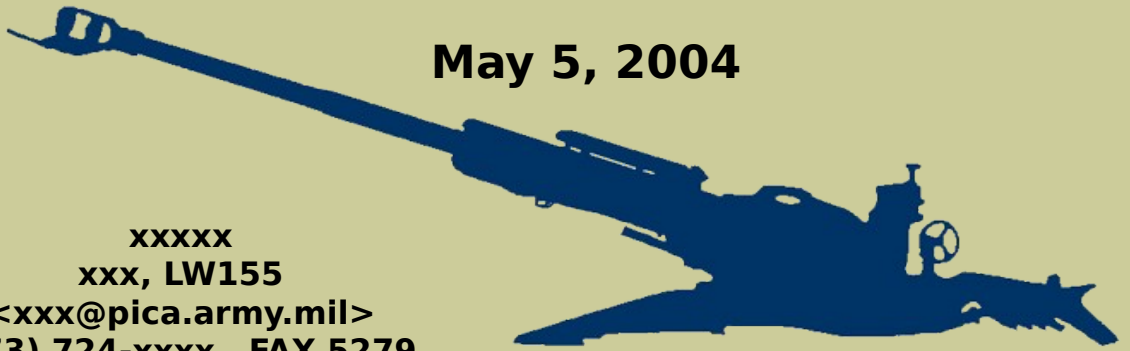
# LW155

## Program Brief
to
## Fire Support Conference

**May 5, 2004**



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# Outline

- M777 Requirements
- Background
- International
- Supply Chain
- Towed Artillery Digitization
- Testing
- Arctic Video
- Summary

# LW155 System M777 and TAD

*The Future of Towed Cannon*

## M777 Howitzer

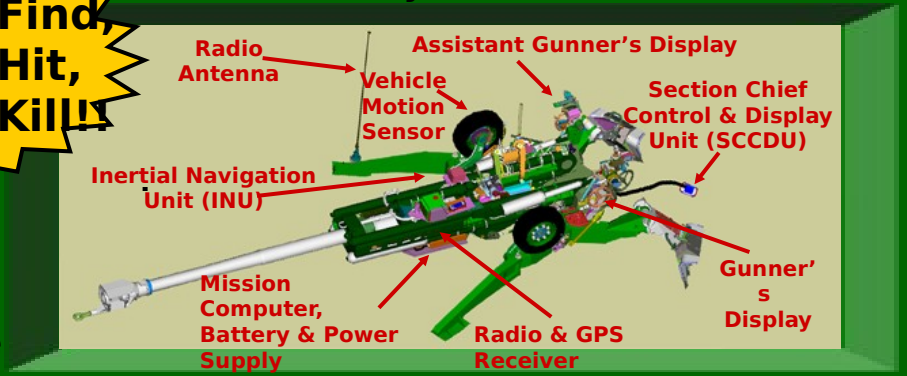
- Lightweight High-Strength Titanium
- Improved Strategic Deployment
- Improved Ground Mobility
- Improved Survivability

## Towed Artillery Digitization (TAD)

- Flexible Operations
- No Survey

**Harder to Find,
Harder to Hit,
Harder to Kill!!**

- Improved Accuracy
- More Responsive



# Joint Requirements for M777 & TAD

*The Future of Towed Cannon Artillery*

## M777

- 10,000 Lbs. or Less - Deployable and Mobile*
- Emplace in 3 Min*
- Displace in 2 –3 Min*
- All USAF (2 per C130, LW155 & FMTV in C141)
- Rate of Fire 4-8 RPM, Sustained 2 RPM
- Max Range 30km with Rocket Assist
- Bold Shift in 3 Min
- Primer Feed Mechanism
- 800 to 900 Rds Between Systems Abort

• Key Performance Parameters

## Towed Artillery Digitization (TAD)

- Digital Indirect Fire Control
- Inertial Navigation with GPS Backup
- 1-Mil Pointing Accuracy
- TAD Weight: 200-500 Pounds

# Program Evolution

*The Future of Towed Cannon Artillery*

Continuous Live Fire Test & Feedback from Troops

1996 — LW155 Shoot-off

1997 — Contract Award & EMD Gun Design (8 Guns)

1998 — Textron Novation

2001 — Extensive Developmental Testing

2002 — Final Developmental Testing

2002 — OA, MS C and Low Rate Production

2004 — USMC IOC

2005 — OT & Full Rate Production De

2006 — US Army TAD IOC

# Why LW155?

*The Future of Towed Cannon Artillery*

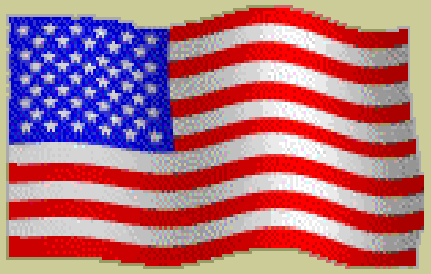
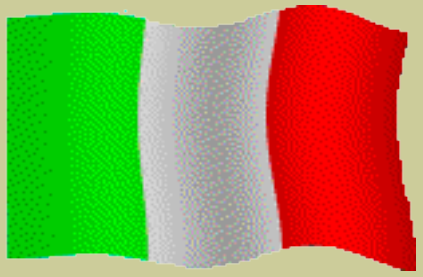
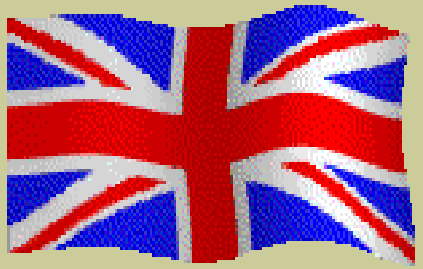
**More Mobile, More Rapidly Deployable, More Survivable and More Accurate than the M198**

| | LW155 | M198 | Improvement |
|---|---|---|---|
| Weight | 10,000 lbs. | 16,000 lbs | 38% |
| Emplaces | 2:28 min | 6:35 min | 260% |
| Displaces | 2:15 min | 10:40 min | 470% |
| Terrain Trafficable | 83% | 63% | 32% |
| C-130 Transport | 2 | 1 | 100% |
| TAD Ready | Yes | No | 70%* |

* Contributes to 70% Increase in Survivability

# Allied Involvement in LW155

*The Future of Towed Cannon Artillery*

- Italy and United Kingdom
- Trilateral EMD MOU, March 99
- Both Provided Supplemental Funding
  - Both Provide Engineer to Program Office
- Production MOU (US & UK) Signed
  - Italy Will Not Participate at This Time – Budget Issue
  - Left Door Open to Join Later

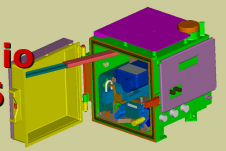
GENERAL DYNAMICS
Strength on Your Side™
Digital Fire Control
Burlington, VT
BAE SYSTEMS
Prime Contractor & Developer,
Elevating Mass & Cradle Assembly
Barrow-in-Furness, England
Wegmann
USA Elevating
Gear
ynchburg, VA
Howmet
Castings
an Alcoa business
ALCOA
Upper Carriage
Whitehall, MI
LW155
TOWED ARTILLERY DIGITIZATION
Joint Program Office
Picatinny Arsenal, NJ
SEILER
INSTRUMENT
OFC
St Louis, MO
MITCHELL
CANADA
Aluminum
Castings
Saint-Laurent,
Quebec
Cannon Assembly
Watervliet Arsena
Watervliet, NY
RTI
International
Metals, Inc.
Titanium
Niles, OH
Hydro-Mill Co.
A Triumph Group Company
Body
Assembly
Hydro-Mill
GENERAL DYNAMICS
Canada
Mission Computer
Software and
Displays
PCC
Precision Castparts Corp.
Lower Carriage
Portland, OR

# Towed Artillery Digitization

Gunner & Asst Gunner Displays

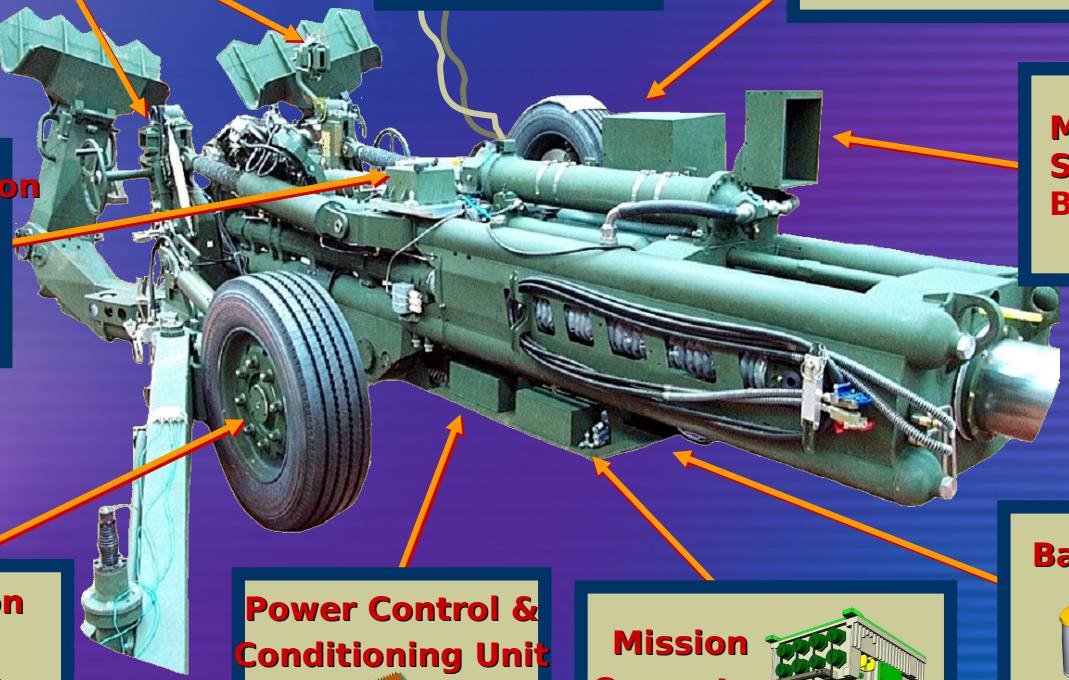
Section Chief Control Display Unit

Communications Box
- Radio
- GPS

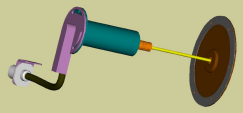


Inertial Navigation Unit

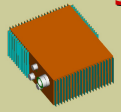
Muzzle Velocity System (MVS) Block 1 = Interfaces



Vehicle Motion Sensor



Power Control & Conditioning Unit



Mission Computer

Batteries

# TAD Block 1 Functionality

*The Future of Towed Cannon Artillery*

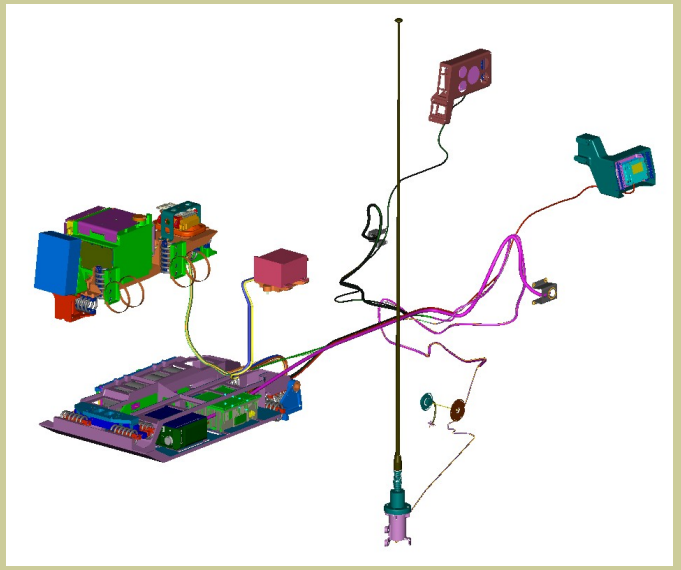
- Self Locating
- Navigation & Emplacement Aid
  - Manual entry of destination point
  - Graphical steer-to prompt
  - Voice Reporting of Howitzer Position to FDC
- Communicate
  - On-Board Long Distance Comms with the FDC, Wire & Wireless
- Display of Commanded and Actual Gun Orders to Gunner & AGunner
  - Graphical laying aid
  - Gunner - El and Def
  - AGunner – El only
- Chief of Section Data Display
  - Initialization
  - Move/Navigation,
  - Fire commands and gun orders
  - Comms Setup
    - Gun number
    - Wire or Radio
  - System Status
    - BIT results
    - Battery state of charge
  - Maintenance
  - System setup (boresight)
- Limited Built In Test (BIT, power up + periodic)
- Self contained power
  - On-board Lead Acid Batteries
  - Power management of displays
  - Multi-source compatibility

## Future Upgrade Areas

# Towed Artillery Digitization Development

*The Future of Towed Cannon Artillery*

- All Critical LRU Qualification Testing Completed
- Risk Reduction Testing on PP1 Complete
- Hardware Integrated Onto 1008, PP1 and PP2
- E3 Testing @ WSMR Complete
- Dry Run FQT of Software Complete; FQT Starts 30 March
- Completed DT @ YPG & Alaska OT



# Displays

*The Future of Towed Cannon*

**Chief of Section Display**
**GDC Canada**

**Asst./Gunner Display**
**GDC Canada**

# Accuracy Results

*The Future of Towed Cannon Artillery*

- M795 HE Projectile with M203A1 Propelling Charge
- Level Ground and 7 deg cant
- Range ~18,500 meters
- Two Different Propellant Lots

* Verified by ATEC

| Type of Mission | CEP Requirement Meters | CEP* Demonstrated Mean Meters |
|---|---|---|
| Low Angle | <150 | 90 |
| High Angle | <275 | 138 |

**Exceeded Accuracy Requirement**

# M777/E1
# Fly Weight

*The Future of Towed Cannon Artillery*

| | | |
|---|---|---|
| **LRIP SPEC Requirement** | **9224 Lbs** | **(+/- 25 Lbs)** |
| **BAE Estimate 9239 Lbs** | | |
| **Initial Barrow Parts Heavier** | **10 Lbs** | |
| **Initial US Parts Heavier** | **66 Lbs** | |
| **Predicted Weight of M777** | **9317 Lbs** | |
| **Weight of DFCS** | **455 Lbs** | |
| **Predicted Weight of M777E1** | **9772 Lbs** | |

# Objective Program

*The Future of Towed Cannon Artillery*

## Block 1

Excalibur Hardware

Excalibur Integration Software

## Block 2

TAD Objective Software

**Objective**

APS+ DFCS Development

Design Integration

M777 Gun Development

M777 MS C

M777E1 FRPD

M777E1 System Integration, TT & OT

M777 Gun LRIP

M777 IOC

M777A1 IOC

M777A1 Production

Objective M777A1 System (M777 with Block 1 TAD)

| FY02 | FY03 | FY04 | FY05 | FY06 | FY07 |
|---|---|---|---|---|---|

Mod In Service

# M777/E1 Testing

# Developmental Testing

*The Future of Towed Cannon Artillery*

✓ Completed

## (Yuma Proving Ground)

- ✓ HFE Validation
- ✓ Firing Tables
- ✓ Initial TAD Component Firing
- ✓ •Strategic Lift
- ✓ Helo Lift
- ✓ Artic Evaluation (Ft Greely,A

## (Yuma Proving Ground)

- ✓ Firing Tests
- ✓ •Extreme Temperature
- ✓ •NBC Decon. (Dugway
- ✓ •Manned Rate of Fire
- ✓ •Accuracy
- ✓ •Safety Release Testir
- ✓ •Reliability Growth

## (Aberdeen Proving Ground)

- ✓ •Automotive Certification Testing
- ✓ •Rail Impact
- ✓ •Corrosion

## (Twenty-Nine Palms)

- ✓ Logistics Demonstration
  - ✓ •Verify Manuals
    - ✓ Operator
    - ✓ Maintenance
  - ✓ Verify Training Materia

# Operational Assessment Issues Then and Now

*The Future of Towed Cannon Artillery*

| | MS C | Now | Rationale |
|---|---|---|---|
| **Displacement (KPP)**<br>**Minutes** | | | Demonstrated 2 min. 15 sec. During OA<br>KPP Changed from 1-2 min to 2-3 min |
| **Max Rate of Fire**<br>**Rounds Per Minute (RPM)** | | | Demonstrated 3.28 RPM During OA<br>Requirement is 4-8 RPM<br>Performance Driven by Environmental Factors During OA<br>User Agreement to Test in Benign Environment in Accordance With JORD |
| **Reliability**<br>**Mean Rounds Between System Abort (MRBSA)** | | | Demonstrated 227 MRBSA During OA<br>Requirement is 800 MRBSA<br>Initiated Reliability Growth Program<br>Current Point Estimate @ 1099 MRBSA after 7700 Equivalent Rounds Fired |

# M777E1
# Alaska DT/OT Update

*The Future of Towed Cannon*

- **DT Completed**
  - Towed 260 miles on Snowpack, Muskeg, Secondary Roads
  - Direct Fire 18 of 26 hits @ 1500m
  - Strength of Design (30 Top Zone) Rounds in Fully Frozen Soil Conditions
  - Accuracy 108M CEP Demonstrated vs. 120M Required (Prelim Data)
  - Completed Technical Safe Rate of Fire (~90 Rnds)
- **Training/OT Complete**
  - 1220 Rounds Fired
  - 445 Miles Towed
  - 3 System Aborts
    - 1 - Operator Error
    - 2 - Cotter Clip

**Alaska Live Fire**

**Extreme Cold Conditions (Down to -56 Deg F)**

**Crew Feedback Overwhelmingly Positive**

# Near Term Testing

*The Future of Towed Cannon*

| | 2004 | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **GUN** | **Jan** | | **Feb** | | **Mar** | | **Apr** | | **May** | | **Jun** | | **Jul** | | **Aug** | | **Sep** | **Oct** | **Nov** |
| 1005 | | | | ONR/Scav/Damper/Excalibur | | | | | | | | | | | | | | | |
| 1008 | | | | | FQT | | | | | | | | | | | | | | |
| PP1 | Arctic | | | | | Nav/Mobility/Fording | | | | NBC | | | | | | | | | |
| PP2 | Arctic | | | | | | LVAD | | | | | | | | | | | | |
| LRIP1 | | | | | △ | Log Demo (Hattiesburg) | | | Log Demo (29 Palms) | | | | | | | | Training | | |
| LRIP2 | | | | | | | △ | Tiedown/Helo/MV22 | | Rail | Towing | | | | | | Training | MOT&E Spare | |
| LRIP3 | | | | | | | | | △ | PQT | | | | | | | | | |
| LRIP4 | | | | | | | | | | △ | FAT | | | | | | | | |
| LRIP5 | | | | | | | | | | | | | △ | | YPG | | Training | MOT&E | |
| LRIP6 | | | | | | | | | | | | | | △ | YPG | | Training | MOT&E | |
| LRIP7 | | | | | | | | | | | | | | | △ YPG | | Training | MOT&E | |
| LRIP8 | | | | | | | | | | | | | | | △ YPG | | Training | MOT&E | |
| | | | | | | | | | | | | | ◇ Safety Test Completed 25 June | | | | | | |

△ = Gun Delivery

# Summary

- Low Rate Initial Production Ongoing
  - Delivering Guns for FAT/PQT & OT
- TAD Fully Integrated with Gun
- M777E1 Alaska OT Complete
- M777 Objective Reliability Demonstrated
- Full Rate Production Decision Jan 05

# Back-Ups

# Excalibur Description

***The Future of Towed Cannon Artillery***

***Mission Statement:***

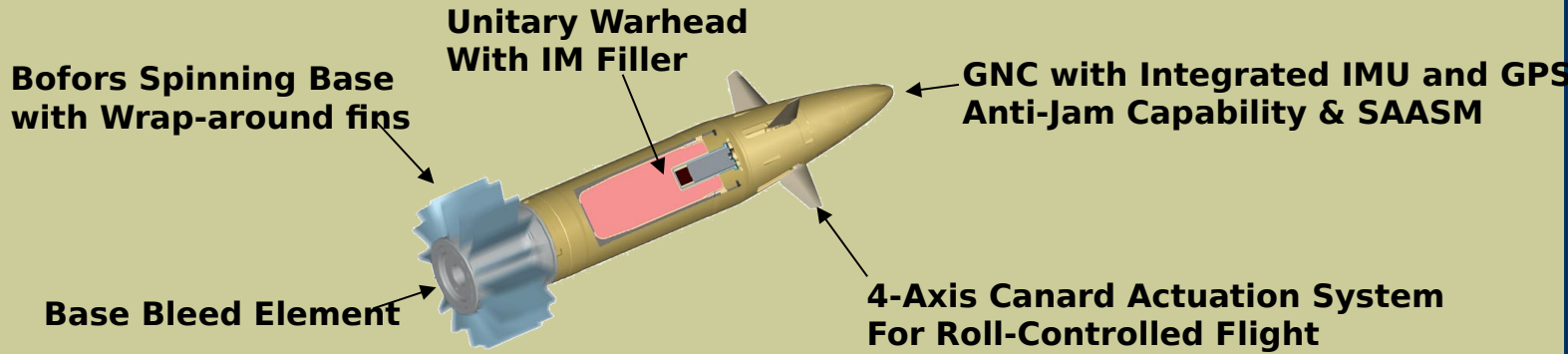
Provides improved fire support through a Precision Guided Extended Range family of 155mm projectiles with greatly increased accuracy and reduced collateral damage in support of the Objective Force.

***Characteristics / Description:***

- Precision Guided, Extended Range Carrier for a Family of 155mm Cannon Ammunition
- Fin Stabilized Glide Air Frame
- All Weather, Day/Night, Fire & Forget, Urban/Complex Terrain
- One Meter Length / 106 lb
- Compatible w/ J LW & FCS 155mm Dgtzd. Platforms

***Capability / Improvements:***

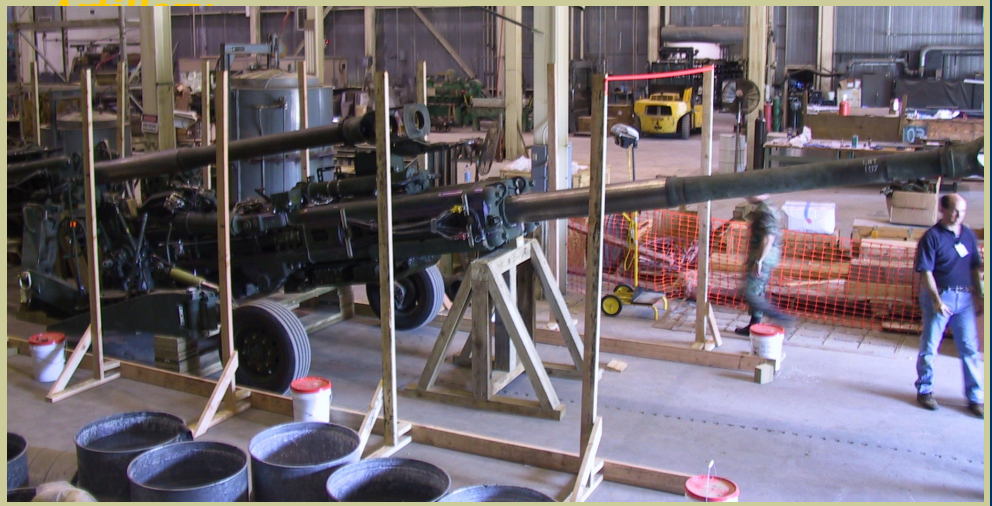
- Objective Maximum Range: 50 km
- Increased Accuracy (150 - 4000%)
- 10-20 meter CEP at all Ranges
- Increased Lethality & Survivability
- Precision Delivery Decreases Collateral Damage
- Decreases Volume of Fire Per Engagement
- Technology Refresh through Block Development



# C-130 Loading Trial Status

*The Future of Towed Cannon Artillery*

- C-130 Mock-up test completed
- 2 M777E1's fitted in C-130 @ Yuma
- Load Procedures and Transportability Plan updated and re-issued
- New Balancer Eye Tie Down identified and evaluated
- FEA that validates individual tie-down completed



**Certification Received for 2 Weapons in a C-130**

# Multi-Year Procurement

*The Future of Towed Cannon Artillery*

- Full-Rate Multi-Year Strategy Approved by Mr. Young in June 03
- Marine Corps & Army Have Both Submitted MY Budget Documentation
- Ongoing Effort With BAE & Watervliet Arsenal to Reduce Costs
- Sole Source Action Being Staffed Through Army
  - Army Has Contracting Lead
  - Currently with Assistant Secretary's Staff (ASALT)
- Congressional Coordination/Action Ongoing

**Over $500M - Will Need Specific Authorization Language**

- Coordination Ongoing With OLA & OCLL

**Will Need To Notify Congress 30 Days Prior To Award**

# Excalibur
# Concept of Operations

- Precision Delivery Regardless of Range
- Limits Collateral Damage
- Decreases Volume of Fire Per Engagement
- Enhances Soldier Survivability

GPS Acquisition and Track

Deploy Canards

System Initialization

Midcourse Trajectory Corrections

Height of Burst Sensor for Fragmenting Warhead

Structure - Top Attack (Detonation after Penetration)

- Gun Target Location
- Trajectory Information
- GPS Crypto Keys
- Precise Time
- Fuze Setting
- Data Download

Mission Planning

Latitude / Longitude / Altitude

Targeting

***Unitary Warhead XM982 Is Designed To Meet User Needs***

# Program Plan
# M777 / TAD

## *The Future of Towed Cannon Artillery*

| Updated 25 Nov 03 | FY95 | FY96 | FY97 | FY98 | FY99 | FY00 | FY01 | FY02 | FY03 | FY04 | FY05 | FY06 | FY07 | FY08 | FY09 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Phases | | | XM777 Engineering & Manufacturing Development | | | | | | | LRIP | Production | | | | |
| Milestones | MS 0 | MS I/II | | | | | LL Cannon | LL Weapon | MS C | FRPD | IOC | | | | |
| Contract Award | | | EMD | | | | | | LRIP | | | | | | |
| Deliveries | | | 1 Shoot Off Howitzer | | Novated EMD | | 10 EMD Guns | | | 34 | 60 | 110 | 120 | 53 | |
| DT | | Shoot Off | | Gun 003 Test | | | DT | | | PQT/FAT | | | | | |
| OA/ OT | | | | | | | | OA | | OT | | | | | |
| Phases | | | | 155 Automated Howitzer Demo | | TAD SDD | | | | Production | | | | | |
| Milestones | | | | | MS I/II | | | IPR | | | MS C | IOC | | | |
| Contract Award | | | | | | EMD | | Novated | | | | | | | |
| Deliveries | | | | | | | | | | | | 18 | 18 | 72 | 125 |
| Joint DVT/ TT | | | | | | | | | DVT | | | | | | |
| LUT/ OT | | | | RFPI ACTD | RFPI Extended User Evaluation | | | | | OT | | | | | |

**AAO 380**
**317 Funded**

**AAO 368**
**233 Funded**

**Marines Fund Weapon R&D for Both Services**

**Army Funds TAD R&D for Both Services**

| USMC and ARMY | | FY95 | FY96 | FY97 | FY98 | FY99 | FY00 | FY01 | FY02 | FY03 | FY04 | FY05 | FY06 | FY07 | FY08 | FY09 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| USMC | RDTE | 6.3 | 14.4 | 13.5 | 36.2 | 31.8 | 26.3 | 13.4 | 14.6 | 11.4 | 5.8 | | | | | | 173.7 |
| | Production | | | | | | | 11.0 | 0 | 62.0 | 111.5 | 175.5 | 177.1 | 73.6 | | | 610.7 |
| | M777 Ordered | | | | | | | | | 34 | 60 | 97 | 93 | 33 | | | 317 |
| ARMY | RDTE | | | | | 1.0 | 4.7 | 16.7 | 18.9 | 21.0 | 32.1 | 8.8 | 1.0 | | | | 104.2 |
| | Production | | | | | | | | 1.1 | 0 | 5.0 | 37.3 | 46.9 | 128.4 | 191.4 | 3.5 | 413.6 |
| | M777A1 Ordered | | | | | | | | | | | 18 | 18 | 72 | 125 | | 233 |